Title: Evaluating the impact of introducing standardized packaging with larger health warning labels in England: Findings from adult smokers within the EUREST-PLUS ITC Europe Surveys

Short running title: Evaluating the impact of standardized packaging

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ABSTRACT

Background

The European (EU) Tobacco Product Directive (TPD) was implemented in May 2016 to regulate the design and labelling of cigarettes and roll-your-own (RYO) tobacco. At the same time, the United Kingdom introduced standardized packaging measures, whereas Germany, Greece, Hungary, Poland, Romania and Spain did not. This study examined the impact of introducing standardized packaging in England using a quasi-experimental design.

Methods

Data from adult smokers in Wave 1 (2016; N=9,547) and Wave 2 (2018; N=9,724) from ITC surveys (England) and EUREST-PLUS surveys (Germany, Greece, Hungary, Poland, Romania, Spain) were used. Generalized estimating equations (GEE) were used to estimate changes in pack/brand appeal, salience of health warning labels (HWLs) and perceived relative harm of different brands in England (where larger HWLs and standardized packaging were implemented), versus each EU country (where only larger HWLs were implemented).

Results

There was an increase in the percentage of respondents across the seven countries with an emphasis from Germany, Hungary, and Poland reporting they did not like the look of the pack (4.7%, 9.6%, and 14.2% respectively), but the largest increase was in England (41.0%). Moreover, there was a statistically significant increase in the salience of HWLs in Hungary, Poland, and Romania (17.0%, 13.9%, and 15.3% respectively), but the largest increase was in England (27.6%). Few differences were observed in cross-country comparisons of the perceived relative harm of different brands.

Conclusions

Findings suggest that standardized packaging reduces pack appeal and enhances the salience of HWLs over and above the effects of larger HWLs. Findings provide additional evidence and support for incorporating standardized packaging into the EU TPD.

BACKGROUND

Over the last few decades, many countries have imposed restrictions on tobacco marketing through bans on advertising on television, radio, billboards and point-of-sale displays (1). Branded packaging represents one of the last remaining channels for tobacco advertising among countries with comprehensive marketing bans (2). The tobacco industry uses pack design elements, such as the colour of cigarette packs, to distinguish brands, promote specific brand imagery and target specific sub-groups (3–6). To counter this form of advertising, standardized packaging has been recommended in the WHO Framework Convention for Tobacco Control (FCTC) guidelines under Articles 11 and 13 to reduce the appeal of tobacco products, increase the noticeability and effectiveness of HWLs , and reduce the use of packaging design to mislead consumers into believing that some products are less harmful than others (7-9).

In England, standardized packaging was introduced in May 2016, requiring cigarettes and rolling tobacco to be sold in brown-coloured packaging (Supplementary Figure 1) (10). At the same time, new measures were introduced under the European Tobacco Products Directive (TPD) that required larger, combined text and graphic HWLs on packaging, covering 65% of the front and the back of cigarette and roll-your-own tobacco (RYO) packs and included a ban on promotional and misleading elements on tobacco products (11), thus leading to a unique opportunity to assess the two policies.

Systematic reviews indicate that standardized packaging reduces the appeal of tobacco products (12-14). For instance, studies have demonstrated that cigarettes in standardized packs are perceived to be of lower quality, compared to branded packs (15,16). Studies have also shown that standardized packs increase the noticeability of HWLs, compared to branded packs (17,18); with respect to HWLs, those that were larger and included pictorial health warnings were found to be more effective than smaller text-based messages (19). A recent review examining the impact of standardized packaging on the perceived relative harm of different brands showed mixed findings (13). Studies indicate that factors such as the presence of descriptors (e.g., smooth, gold) may play a role in shaping harm perceptions; these factors may explain the discrepancies observed in previous studies (5,20). Given that standardized packaging does not restrict the use of descriptors, the tobacco industry is still able to use descriptors as a way of misleading consumers into thinking that some brands are less harmful than others.

Though reviews to date have shown that standardized packaging may increase the salience of HWLs and reduce pack appeal, one key limitation of studies to date is that they do not account for the confounding effects of concurrently introducing larger HWLs (13,21). In all published studies to date, standardized packaging has been implemented at the same time as larger HWLs. As such, it has not been possible to separate the effects of larger HWLs from standardized packaging. As more countries adopt standardized packaging, evaluations of natural experiments comparing jurisdictions that introduce only HWLs versus combined policies (i.e., HWLs and standardized packaging) may offer timely evidence that addresses this limitation (22).

The distinct policies implemented relating to standardized packaging in Europe along with the EU-wide implementation of larger HWLs under the TPD offer a unique opportunity to evaluate its impact within the context of a natural experiment. The primary objective of this study was to evaluate the impact of introducing larger HWLs and standardized packaging in England against the impact of only introducing larger HWLs in Germany, Greece, Hungary, Poland, Romania and Spain. Specifically, the study examined the impact of standardized packaging on perceptions of (a) pack/brand appeal; (b) salience of HWLs and (c) relative harms of different brands. We hypothesized that standardized packaging would reduce pack appeal, enhance the salience of HWLs and reduce misperceptions of harm associated with different brands.

METHODS

Design

The International Tobacco Control Policy Evaluation (ITC) Project is a prospective cohort study designed to investigate the psychosocial and behavioural effects of tobacco control policies, at national and international levels. This study used data from seven participating European countries. Longitudinal data from Germany, Greece, Hungary, Poland, Romania and Spain were derived from Wave 1 (2016) and Wave 2 (2018) of the ITC 6 European Countries (6E) survey, as part of the Horizon 2020-funded project European Regulatory Science on Tobacco: Policy implementation to reduce lung diseases (EUREST-PLUS). The ITC 6E survey was designed to evaluate the impact of the implementation of the TPD and FCTC policies in the EU (23). Longitudinal data from England were derived from Wave 1 (2016) and Wave 2 (2018) of the ITC England Survey (24).

Data from the ITC 6E survey were collected through face-to-face interviews conducted using computer-assisted personal interviews (CAPI) (23). Interviews were conducted with adults aged 18+ years who smoked at least monthly and had smoked at least 100 cigarettes in their lifetime. The sampling design used geographic strata defined by Nomenclature of Territorial Units for Statistics (NUTS) regions crossed with degree of urbanization (urban, intermediate, rural). Approximately 100 clusters were sampled within each country; within each cluster, 10 adult smokers were interviewed. In each cluster, interviewers utilized a random walk design in the selection of household addresses to approach. From each household sampled, one male and one female smoker were selected for an interview, where possible. The screening process continued until the required number of smokers from each stratum was reached. Wave 1 and 2 of the ITC 6E survey were conducted from June to September 2016 and February to May 2018 respectively. The retention rates between both waves were ~70% in Germany and Spain but ranged from 36-55% in other 6E countries, resulting in the use of replenishment samples at Wave 2.

Data from the ITC England Survey were collected online using probability-based sampling frames, non-probability opt-in panels or a combination of both (24). The sample was comprised of individuals aged 18+ and included: 1) re-contacted smokers and quitters who had participated in previous waves of the study; 2) newly recruited current smokers and recent

quitters (quit ≤ 2 years) and; (3) newly recruited e-cigarette users who reported at least weekly use. Waves 1 and 2 of the ITC England Survey was conducted from July to September 2016 and February to July 2018, respectively. The retention rates between both waves was ~39%; as such, replenishment samples were used at Wave 2.

Additional details regarding the survey methodology used can be found elsewhere (23-25). The analytic sample consisted of adult smokers that participated at Wave 1 (N=9,547) and Wave 2 (N=9,724) of the EUREST-PLUS and ITC England Surveys. These surveys will be collectively referred to as the EUREST-PLUS ITC Europe Surveys. Sample characteristics at both waves are provided in Supplementary Table 1.

Measures

Demographics and smoking-related measures

Respondents were asked to report their gender (male or female), age group (18-24, 25-39, 40-54, 55+), education (low, moderate, high), and household income (low, moderate, high, not reported). A separate variable was created to identify respondents' country of residence (England, Germany, Greece, Hungary, Poland, Romania, Spain).

Nicotine dependence was measured using the Heaviness of Smoking Index (HSI) (26). HSI was calculated as the sum of two categorical measures: number of cigarettes smoked per day and time to first cigarette of the day. Consistent with previous research (27), HSI scores between 0-1 were classified as low, 2-3 as moderate, and 4-6 as high nicotine dependence. Respondents were asked to report whether they had made an attempt to quit smoking within the past year (Yes/No).

Outcome Variables

Pack/brand appeal: Respondents were asked, 'To what extent do you like the look of your cigarette pack?' Consistent with previous research (15), response options were dichotomized into 'not at all' versus otherwise (i.e., 'a little/somewhat/quite a lot/very much/I don't know'). Respondents were also asked, 'Now, thinking about the quality of your cigarettes, would you describe them as: very high quality, high quality, medium quality or low quality?' As in previous work (15), response options were dichotomized into 'very high/high' versus otherwise (i.e., 'medium/low quality/I don't know'). Respondents were asked, 'How much do brands differ in terms of how prestigious they are?' Response options were dichotomized into 'a little/somewhat/very different' versus otherwise (i.e., 'not at all/I don't know').

Salience of HWLs: Respondents were asked, 'When you look at a cigarette pack, what do you usually notice first—the warning labels, or other aspects of the pack such as branding?' Responses were dichotomized into 'warning labels' versus otherwise (i.e., 'other aspects of the pack/I don't know').

Perceived relative harm of different brands: Respondents were asked, 'Based on your experience of smoking, do you think that [your usual brand/the brand you are currently smoking] might be a little less harmful, no different, or a little more harmful, compared to other

cigarette brands?' Consistent with previous research (16), responses were dichotomized into 'no different' versus otherwise (i.e., 'a little less/a little more/I don't know'). Respondents were also asked, 'Is your brand harsher or smoother on your throat compared to other brands?' Response options were dichotomized into 'about the same' versus otherwise (i.e., 'harsher/smoother/I don't know').

Analysis

Descriptive statistics were used to examine demographic and smoking-related characteristics at Wave 1 (2016) and Wave 2 (2018) for the unweighted sample. To address our main research objective, weighted logistic generalized estimating equations (GEE) regression models were used to test changes in perceptions of (1) pack/brand appeal; (2) salience of HWLs and (3) relative harm of different brands in each country between Wave 1 and 2. Logistic GEE models were also used to evaluate the impact of standardized packaging introduced within England on these changes, relative to each of the 6E countries (where standardized packaging was not implemented). This was done by testing the interaction between country and wave for each outcome measure. GEE models accounted for the survey sampling design, sampling weights, and use of repeated measures. GEE models controlled for gender, age, household income, education, nicotine dependence, quit attempts and wave of recruitment. Descriptive analyses were conducted using SAS 9.4, whereas GEE models were estimated using SAS-callable SUDAAN Version 11.0.3.

RESULTS

Pack/Brand Appeal

There was an increase from Wave 1 to Wave 2 in the percentage of respondents from all countries that reported not liking the look of the pack, after adjusting for demographics and smoking-related behaviours with statistical significant increases for Germany, Hungary, and Poland (4.7%, 9.6% and 14.2% respectively); the largest increase was observed in England (41.0%). Between-country comparisons showed that the change from Wave 1 to Wave 2 was greater in England than in each of the six countries (Table 2, all $p < 0.05$). Among respondents from England, there was an increase in reporting that the quality of their cigarettes was high/very high from Wave 1 to Wave 2 ($p=0.013$; Table 1). There was a decrease in reporting that brands differed in prestige among respondents from England ($p=0.01$; Table 1); similar findings were also observed in Romania ($p=0.013$; Table 1).

Salience of HWLs

Among respondents from Hungary, Poland and Romania there was an increase in the percentage of respondents reporting they usually noticed HWLs first before other aspects of the pack, after adjusting for demographics and smoking-related behaviours (17.0%, 13.9% and 15.3% respectively); the largest increase was observed in England (27.6%) (Table 1). Between-country comparisons showed that the increase in England was greater than the change in each of the six countries (Table 2, all $p < 0.05$).

Relative Harm of Different Brands

Among respondents from Romania, there was a decrease from Wave 1 to 2 in reporting that one's own brand was no different in harmfulness compared to other brands, adjusting for demographics and smoking-related behaviours (p=0.015; Table 1). However, no significant changes were observed in other countries (Table 1). Findings showed a decrease in reporting that one's own brand was no different in harshness than other brands among respondents from Romania (p=0.028; Table 1). However, there was an increase in the percentage of respondents from Spain reporting that one's own brand was no different in harshness than other brands from Wave 1 to Wave 2 (p = 0.0001; Table 1). The change in perceived relative harm of one's own brand in England was significantly different than the change in Romania (aOR=1.42). However, the change in England was not significantly different than the change in each of the other five countries. With respect to perceived relative harshness, there was a small increase in England and this change differed significantly from the decreases observed in Romania and Poland (aOR=1.48 and 1.46 respectively; Table 2).

DISCUSSION

This is the first study to date to evaluate the impact of standardized packaging separately from larger HWLs using a rigorous quasi-experimental design. Findings showed that standardized packaging measures introduced in England were effective in reducing pack appeal and increasing salience of HWLs. Standardized packaging did appear to have some effect in correcting perceptions of harm associated with different brands; respondents from England had small increases in perceptions that their own brand did not differ in harshness, compared to Romania and Poland (where decreases were observed). These effects were not observed in any other cross-country comparisons.

Country-specific findings showed an increase in the salience of HWLs in England, Poland, Hungary and Romania post-TPD. As predicted, country comparisons showed that respondents from England had more pronounced increases in salience relative to each of the 6E countries (where standardised packaging was not implemented). These findings reinforce previous research demonstrating that standardised packaging increases the noticeability of HWLs (12–14).

As predicted, the largest changes in pack appeal were observed within England, whereby the change in percentage of respondents reporting they did not like the look of the pack was much greater in England than in other countries. These findings suggest that standardized packaging had an added positive effect of reducing pack appeal over and above increasing the size of the HWLs. Findings also showed reductions in pack appeal in Germany, Hungary, and Poland post-TPD; however, the degree of change in pack appeal varied by country. Country differences are likely attributable to baseline differences (i.e., the pre-TPD regulatory context) within each country. For instance, pre- to post-TPD, some countries moved from text-only to pictorial HWLs, whereas others already had pictorial HWLs in effect pre-TPD (Supplementary Table 2). For the most part, the degree of change in pack appeal across countries appears to reflect the extent of changes to the pack design brought on by the TPD (in

all seven countries) and standardized packaging (in England). Other country-level factors (e.g., prevalence of tobacco use, cultural differences) may also play a role in explaining cross-country differences.

Contrary to initial hypotheses, the extent of changes in perceptions of brand prestige and cigarette quality did not differ between England and each of the 6E countries. These findings were inconsistent with previous evaluations of standardized packaging (13,15). It is worth noting that previous evidence is largely derived from Australian studies, where there were some notable differences in the implementation of standardized packaging. Specifically, the roll-out period for standardized packaging in Australia was much shorter than the U.K. (2 months versus 12 months) (28); this may partially explain the discrepancy in results. These inconsistencies may have also been generated by differences in study design of previous research (i.e., use of experimental, rather than real-world settings). Moving forward, future research is needed to evaluate the longer-term impact of standardized packaging on these outcome measures.

With respect to the impact of standardized packaging on perceptions of the relative harshness of different brands, our study showed mixed findings. The changes observed in England were not significantly different from changes in Hungary, Greece, and Germany. Interestingly, respondents from Spain (where standardized packaging was not in effect) had larger increases in reporting that brands do not differ in harshness over time (i.e., from Wave 1 to 2), relative to changes in England. These findings may reflect the strength of tobacco control policies in effect in each country (Supplementary Table 3). Spain has a higher score on the Tobacco Control Scale (TCS) relative to other EU countries, including Poland, Greece and Germany; a higher score on the TCS indicates stronger tobacco control policies are in effect (29). The discrepancy in findings may also be a function of other factors. Studies have shown that the use of brand descriptors has been found to mislead consumers about the harmfulness of tobacco products (5,20); standardized packaging measures introduced in England did not include restrictions on the use of descriptors. It may be the case that the presence of brand descriptors reduced the impact of standardized packaging on the perceived relative harm of different brands.

Our findings have important implications at a time when many countries are tabling or introducing standardized packaging. This study offers timely evidence that incorporating standardized packaging to the next EU TPD may provide an added benefit of further reducing the appeal of tobacco products and enhancing the salience of HWLs.

The strengths of our study included the use of a rigorous quasi-experimental design that allowed us to separate the effects of standardized packaging from larger HWLs. Our study also included data from seven European countries with distinct policy environments, allowing for a more robust evaluation of the impact of standardized packaging. With respect to limitations, this study focused solely on adult smokers; as such, these findings are not generalizable to non-smokers and youth – which may be more significantly impacted by the implementation of standardised packaging. Furthermore, the England sample did not have comparable survey items in some cases, differed in data collection methods and had more missing data compared

to other country samples; this may have weakened comparisons made between England and other countries. Lastly, country-comparisons may have been influenced by baseline differences (e.g., strength of other tobacco control policies).

Conclusions

This study represents the first evaluation to date to separate the effects of introducing standardized packaging measures from introducing larger HWLs only. Study findings suggest that standardized packaging reduces the appeal of the pack and enhances the noticeability of HWLs over and above the effects of introducing HWLs only. These findings lend support for the incorporation of standardized packaging measures into the EU TPD.

Key Points

- Standardized packaging measures were introduced in England in May 2016 that limited the use of logos, colours and imagery on packaging.
- Our findings showed that standardized packaging measures were effective in reducing the appeal of the pack and enhancing the salience of HWLs.
- Our findings lend support for the incorporation of standardized packaging measures within the EU Tobacco Product Directive.

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Conflicts of Interest

The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results. GTF has served as an expert witness on behalf of governments in litigation involving the tobacco industry. KP reports grants and personal fees from the Polish League Against Cancer, outside the submitted work. AM is a UK National Institute for Health Research (NIHR) Senior Investigator. The views expressed in this article are those of the authors and not necessarily those of the NIHR, or the UK Department of Health and Social Care.

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Table 1: Results of Generalized Estimating Equations (GEE) models testing changes in perceptions of pack/brand appeal, salience of health warning labels (HWLs) and perceptions of relative harm of different brands within each country between Wave 1 and Wave 2 among respondents of the EUREST-PLUS ITC Europe Surveys

	Germany			**Greece**			**Hungary**			**Poland**			**Romania**			**Spain**			**England**		
Outcome Measures	W_1 (%)	W_2 (%)	% diff [a]	W_1 (%)	W_2 (%)	% diff [a]	W_1 (%)	W_2 (%)	% Diff [a]	W_1 (%)	W_2 (%)	% Diff [a]	W_1 (%)	W_2 (%)	% Diff [a]	W_1 (%)	W_2 (%)	% Diff [a]	W_1 (%)	W_2 (%)	% Diff [a]
Pack appeal (No. of observations: N=16,949; No. of individuals: N=13,434 [b])																					
Do not like the look of the pack at all	7.6	12.3	**4.7 ****	9.3	13.6	4.3	5.1	14.7	**9.6 *****	7.9	22.1	**14.2 *****	13.0	15.9	2.9	18.3	15.5	-2.8	13.9	54.9	**41.0 *****
Brand appeal (No. of observations: 16,973; No. of individuals: N=13,449 [b])																					
Quality of their cigs is high/very high	30.3	27.3	-3.0	25.7	23.3	-2.4	24.2	24.7	0.5	47.3	48.8	1.5	55.0	54.9	-0.1	57.5	62.3	4.8	34.8	38.9	**4.1 ***
Brand appeal (No. of observations: N=16,970; No. of individuals: N=13,445 [b])																					
Brands differ in prestige	88.4	86.6	-1.8	94.4	94.0	-0.4	98.6	97.3	-1.3	96.9	96.1	-0.8	94.3	90.3	**-4.0 ***	91.4	91.5	0.1	87.1	83.9	**-3.2 ***
Salience of HWLs (No. of observations: 17,637; No. of individuals: N=13,992 [b])																					
Notice health warning labels first	13.4	12.8	-0.6	9.8	15.1	5.3	29.0	46.0	**17.0 *****	30.3	44.2	**13.9 ****	20.2	35.5	**15.3 *****	20.6	23.9	3.3	18.3	45.9	**27.6 *****
Relative harm of different brands (No. of observations: N=16,969; No. of individuals: N=13,446 [b])																					

Their own brand is no different in harm	85.1	81.8	-3.3	86.9	88.2	1.3	77.0	79.1	2.1	81.0	79.6	-1.4	71.7	64.8	**-6.9 ***	82.4	85.5	3.1	78.1	78.6	0.5
Relative harshness of different brands (No. of observations: N=16,972; No. of individuals: N=13,447 [b])																					
Their own brand is no different in harshness	55.4	59.6	4.2	38.2	40.8	2.6	63.8	67.1	3.3	66.8	60.5	-6.3	55.5	48.3	**-7.2 ***	52.8	70.0	**17.2 *****	30.4	32.6	2.2

[a] Absolute percent difference

[b] Number of observations refers to the total number of observations each respondent contributes to the model, Number of individuals refers to the number of unique respondents present in the model

Note: The weighted estimates shown above are based on the results of a logistic regression model estimated using Generalized Estimating Equations (GEE), adjusting for gender, age, household income, education, wave of recruitment, nicotine dependence (HSI) and past year quit attempts

Note: * p<0.05; ** p<0.01; *** p<0.001

Table 2: Results of Generalized Estimating Equations (GEE) models testing the country by wave interaction effect for outcomes measures relating to pack/brand appeal, salience of health warning labels (HWLs) and perceptions of relative harm of different brands among respondents of the EUREST-PLUS ITC Europe Surveys

	Perceptions of pack and brand appeal			***Perceptions of Salience of HWLs***	***Perceptions of harm/harshness of brands***	
	Do not like the look of the pack at all vs. otherwise	Quality of their cigs is high/very high vs. otherwise	Brands differ at least a little in prestige vs. otherwise	Notices HWLs first vs. otherwise	Their own brand is no different in harm, compared to other brands vs. otherwise	Their own brand is no different in harshness, compared to other brands vs. otherwise
	No. of observations: 16,949 [a]	*No. of observations: 16,973* [a]	*No. of observations: 16,970* [a]	*No. of observations: 17,637* [a]	*No. of observations: 16,969* [a]	*No. of observations: 16,972* [a]
	No. of individuals: 13,434 [b]	*No. of individuals: 13,449* [b]	*No. of individuals: 13,445* [b]	*No. of individuals: 13,992* [b]	*No. of individuals: 13,446* [b]	*No. of individuals: 13,447* [b]
	aOR (95% CI) [c]	aOR (95% CI) [c]	aOR (95% CI) [c]	aOR (95% CI) [c]	aOR (95% CI) [c]	aOR (95% CI) [c]
Changes over time by country interaction [d]						
England vs. Romania	**6.06 (4.21-8.73)**	1.20 (0.94-1.54)	1.38 (0.87-2.20)	**1.74 (1.21-2.50)**	**1.42 (1.06-1.90)**	**1.48 (1.11-1.98)**
England vs. Spain	**9.45 (6.43- 13.89)**	0.98 (0.72-1.31)	0.76 (0.38-1.52)	**3.17 (2.19-4.57)**	0.81 (0.47-1.41)	**0.53 (0.36-0.77)**
England vs. Poland	**2.31 (1.31-4.07)**	1.12 (0.86-1.47)	0.98 (0.47-2.03)	**2.09 (1.39-3.14)**	1.13 (0.79-1.61)	**1.46 (1.04-2.05)**
England vs. Hungary	**2.37 (1.37-4.10)**	1.16 (0.79-1.69)	1.47 (0.64-3.35)	**1.82 (1.25-2.66)**	0.91 (0.64-1.30)	0.96 (0.68-1.34)
England vs. Greece	**4.95 (2.83-8.69)**	1.36 (0.98-1.89)	0.83 (0.52-1.33)	**2.34 (1.26-4.36)**	0.92 (0.61-1.39)	0.99 (0.75-1.31)

England vs. Germany	**4.50 (3.05-6.67)**	1.36 (0.94-1.97)	0.91 (0.63-1.32)	**4.04 (2.70-6.03)**	1.31 (0.91-1.88)	0.93 (0.72-1.19)

[a] Number of observations refers to the total number of observations each respondent contributes to the model

[b] Number of individuals refers to the number of unique respondents present in the model

[c] aOR – adjusted odds ratio; 95% CI- 95% confidence interval; Estimates shown in bold type are significant at $p<0.05$.

[d] The interaction effect between country and wave examines changes over time in key appeal, salience and harm perception-related outcome measures, comparing England (which introduced standardized packaging regulations and larger pictorial HWLs) with the six European countries that each introduced larger pictorial HWLs only. The weighted estimates, shown above, control for gender, age, household income, education, wave of recruitment, nicotine dependence (HSI) and past-year quit attempts.

Supplementary Table 1: Sample characteristics at Wave 1 (W_1: 2016; N= 9,547) and Wave 2 (W_2: 2018; N=9.724) of the EUREST-PLUS ITC Europe Surveys															
		Germany		Greece		Hungary		Poland		Romania		Spain		England	
		W_1	W_2	W_1	W_2	W_1	W_2	W_1	W_2	W_1	W_2	W_1	W_2	W_1	W_2
		N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]	N (%) [a]
Gender	Female	496 (49.5)	495 (52.2)	456 (45.6)	431 (45.3)	479 (47.9)	471 (49.5)	529 (52.6)	515 (54.2)	420 (42.0)	415 (45.1)	456 (45.6)	408 (45.8)	1581 (44.7)	2021 (49.1)
	Male	507 (50.5)	453 (47.8)	544 (54.4)	520 (54.7)	521 (52.1)	481 (50.5)	477 (47.4)	435 (45.8)	581 (58.0)	506 (54.9)	545 (54.4)	482 (54.2)	1955 (55.3)	2091 (50.9)
	frequency missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Age group	18-24	88 (8.8)	67 (7.1)	61 (6.1)	52 (5.5)	59 (5.9)	62 (6.5)	72 (7.2)	87 (9.2)	110 (11.0)	98 (10.6)	117 (11.7)	99 (11.1)	805 (22.8)	1077 (26.2)
	25-39	283 (28.2)	264 (27.8)	255 (25.5)	234 (24.6)	282 (28.2)	270 (28.4)	342 (34.0)	305 (32.1)	300 (30.0)	255 (27.7)	312 (31.2)	260 (29.2)	871 (24.6)	924 (22.5)
	40-54	339 (33.8)	319 (33.7)	383 (38.3)	390 (41.0)	357 (35.7)	337 (35.4)	281 (27.9)	260 (27.4)	321 (32.0)	320 (34.8)	323 (32.3)	325 (36.5)	938 (26.5)	1039 (25.3)
	55+	293 (29.2)	298 (31.4)	301 (30.1)	275 (28.9)	302 (30.2)	283 (29.7)	311 (30.9)	298 (31.3)	270 (27.0)	248 (26.8)	249 (24.8)	206 (23.2)	922 (26.1)	1072 (26.0)
	frequency missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Household Income [b]	Low	306 (30.5)	293 (30.9)	180 (18.0)	170 (17.9)	179 (17.9)	104 (10.9)	173 (17.2)	145 (15.3)	226 (22.6)	198 (21.5)	271 (27.1)	232 (26.1)	774 (21.9)	970 (23.6)
	Moderate	347 (34.6)	327 (34.5)	525 (52.5)	460 (48.4)	290 (29.0)	222 (23.3)	353 (35.1)	299 (31.5)	466 (46.6)	366 (39.7)	268 (26.8)	225 (25.3)	1555 (44.0)	1845 (44.9)
	High	257 (25.6)	237 (25.0)	98 (9.8)	135 (14.2)	220 (22.0)	246 (25.8)	154 (15.3)	166 (17.5)	250 (25.0)	265 (28.8)	68 (6.8)	51 (5.7)	919 (26.0)	1025 (24.9)
	Not reported	93 (9.3)	91 (9.6)	197 (19.7)	186 (19.5)	311 (31.1)	380 (39.9)	326 (32.4)	340 (35.7)	59 (5.8)	92 (10.0)	394 (39.3)	382 (42.9)	288 (8.1)	272 (6.6)
	frequency missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education [c]	Low	509 (50.9)	483 (51.5)	306 (30.7)	281 (29.6)	617 (61.8)	567 (59.6)	123 (12.4)	125 (13.4)	246 (24.9)	246 (26.8)	410 (41.0)	363 (40.8)	1010 (29.1)	1206 (29.9)
	Moderate	417 (41.7)	379 (40.4)	488 (49.0)	498 (52.4)	311 (31.2)	311 (32.7)	753 (76.1)	704 (75.1)	629 (63.6)	586 (63.8)	506 (50.7)	457 (51.4)	1404 (40.5)	1643 (40.8)

	High	75 (7.4)	76 (8.1)	203 (20.3)	171 (18.0)	70 (7.0)	74 (7.7)	114 (11.5)	108 (11.5)	114 (11.5)	87 (9.4)	83 (8.3)	69 (7.8)	1055 (30.4)	1181 (29.3)
	frequency missing	2	10	3	1	2	0	16	13	12	2	2	1	67	82
Nicotine dependence (HSI) [d]	Low	250 (28.3)	244 (28.7)	155 (16.0)	161 (17.3)	130 (13.2)	122 (13.2)	174 (18.5)	192 (21.6)	164 (17.3)	170 (18.9)	334 (34.5)	285 (33.3)	1188 (38.1)	1383 (37.3)
	Moderate	439 (49.8)	414 (48.7)	467 (48.1)	462 (49.5)	563 (57.0)	565 (61.2)	525 (56.0)	484 (54.5)	484 (51.1)	498 (55.4)	426 (44.0)	408 (47.6)	1401 (45.0)	1671 (45.1)
	High	193 (21.9)	192 (22.6)	348 (35.9)	309 (33.2)	295 (29.8)	237 (25.6)	239 (25.5)	212 (23.9)	299 (31.6)	231 (25.7)	209 (21.5)	164 (19.1)	528 (16.9)	650 (17.6)
	frequency missing	121	98	30	19	12	28	68	62	54	22	32	33	419	408
Past year quit attempts	No	817 (81.5)	821 (86.9)	842 (84.2)	853 (89.7)	891 (89.1)	872 (91.7)	822 (82.1)	817 (86.0)	726 (72.6)	717 (77.9)	830 (82.9)	722 (81.2)	1842 (52.1)	2729 (66.4)
	Yes	186 (18.5)	124 (12.1)	158 (15.8)	98 (10.3)	109 (10.9)	79 (8.3)	179 (17.9)	133 (14.0)	274 (27.4)	203 (22.1)	171 (17.1)	167 (18.8)	1694 (47.9)	1383 (33.6)
	frequency missing	0	3	0	0	0	1	5	0	1	1	0	1	0	0
Wave of recruitment	Recruited during earlier waves [e]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	173 (4.9)	132 (3.2)
	Wave 1	1003 (100)	645 (68.0)	1000 (100)	354 (37.2)	1000 (100)	309 (32.5)	1006 (100)	413 (43.5)	1001 (100)	463 (50.3)	1001 (100)	596 (67.0)	3363 (95.1)	1158 (28.2)
	Wave 2	--	303 (32.0)	--	597 (62.8)	--	643 (67.5)	--	537 (56.5)	--	458 (49.7)	--	294 (33.0)	--	2822 (68.6)
	frequency missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Percentages are based on unweighted estimates

[b] Monthly gross household income, categorized as low (<€1750 for Germany, Greece & Spain, ≤150,000 Ft for Hungary, ≤2,000 zł for Poland, ≤1,000 lei for Romania, ‹ £15,000 for England), moderate (€1750 to €3000 for Germany, Greece & Spain, 150,001-250,000 Ft for Hungary,2,001- 4,000 zł for Poland, 1,001- 2,500 lei for Romania, £15,001-40,000 for England) and high (>€3000 for Germany, Greece & Spain, >250,000 Ft for Hungary, >4,000 zł, for Poland, >2,500 lei for Romania, > £40,000 for England).

[c] Highest level of formal education completed, categorized as low (primary; lower pre-vocational secondary, middle pre-vocational secondary), moderate (secondary vocational; senior general secondary and pre-university), and high (higher professional and university bachelor, university master)

[d] Nicotine dependence, categorized as low (a score of 0-1 on the heaviness of smoking index), moderate (a score of 2-3 on the heaviness of smoking index), high (a score of 4-6 on the heaviness of smoking index).

[e] 'Recruited during earlier waves' refers to participants in England who were recruited in earlier years as part of the original ITC survey.

Note: **--**: not applicable

Supplementary Table 2: Changes to cigarette packaging before and after the implementation of the European Tobacco Product Directive (in all 7 EU countries) and standardized packaging measures (in England)		
Country	**Pre-TPD and standardized packaging measures**	**Post-TPD and standardized packaging measures**
England	• Pictorial health warnings on back surface of the pack • Text warnings on the front of the pack • Health warnings were required to cover 43% of the front of the pack and 53% of the back of the pack	• Combined text and pictorial health warning labels that cover 65% of the front and back of packaging required under EU TPD • All cigarette packs must now be in standardized packaging. Packs must be in a non-shiny drab brown. All logos, colours and promotional images are prohibited.
Country	**Pre-TPD**	**Post-TPD**
Germany	• Text-only health warnings • Health warnings cover 30% of the front of the pack and 40 % of the back of the pack	• Combined text and pictorial health warning labels that cover 65% of the front and back of packaging required under EU TPD
Greece	• Text-only health warnings • Health warnings cover 30% of the front of the pack and 40 % of the back of the pack	• Combined text and pictorial health warning labels that cover 65% of the front and back of packaging required under EU TPD
Hungary	• Pictorial health warnings on the back surface of the pack • Text warnings on the front of pack • Health warnings cover 30% of the front of the pack and 40% of back of the pack.	• Combined text and pictorial health warning labels that cover 65% of the front and back of packaging required under EU TPD

Poland	• Text-only health warnings • Health warnings cover 30% of the front of the pack and 40 % of the back of the pack	• Combined text and pictorial health warning labels that cover 65% of the front and back of packaging required under EU TPD
Romania	• Pictorial health warnings on the back surface of the pack • Text warning labels on front of the pack • Health warnings cover 43% of the front of the pack and 53% of the back of the pack	• Combined text and pictorial health warning labels that cover 65% of the front and back of packaging required under EU TPD
Spain	• Pictorial health warning on the back surface of the pack • Text warnings on front of the pack • Health warnings cover 43% of the front of the pack and 53% of the back of the pack	• Combined text and pictorial health warning labels that cover 65% of the front and back of packaging required under EU TPD

Supplementary Table 3: Overview of tobacco control policies in effect in each of the 7 countries included in the EUREST-PLUS ITC Europe Surveys prior to 2016.

Country	Tobacco Taxes (% of retail price, 2016) [a]	Smoke free legislation	Advertising & Promotion	Presence of Mass Media Campaigns between 2014-2016	Score on 2016 Tobacco Control Scale [b] (Higher score indicates stronger policies)
England	81 %	Total bans in enclosed public places, workplaces, restaurants, bars and public transport. Smoking permitted in hotel rooms, residential care and prisons (2006).	Comprehensive ban: banned in all broadcast media, print media (2003), outdoors (billboards, posters; 2003) and at point of sale (2015)	Yes	81
Germany	70%	Bans on smoking in enclosed public places, workplaces, restaurants, bars and public transports (2007). In most states, separate smoking rooms are permitted.	Banned in all broadcast media and print media. Outdoor and point of sale advertising permitted	Yes	37
Greece	81%	Total bans on smoking in enclosed public places, workplaces, restaurants and public transport (2003) -enforced in 2019. Exemptions for bars and prisons.	Ban in all broadcast media, print media, outdoors (billboards, posters). Point of sale advertising permitted	No	40
Hungary	74%	Total bans on smoking in enclosed public places, workplaces, restaurants, bars, public transport and bars. Bans at outdoor public transportation spots/stations (2012)	Banned in all broadcast media, print media, outdoors (billboards, posters). Point of sale advertising permitted	No	53
	78%	Total ban on smoking in enclosed public places. Partial bans in restaurants, bars, workplaces and	Comprehensive ban: banned in all broadcast media, print media, outdoors	Yes	50

Poland		prisons (designated rooms with effective ventilation systems are required). Bans at outdoor public transportation spots/stations (2010)	(billboards, posters) and at point of sale		
Romania	72%	Bans on smoking in enclosed public places, workplaces, residential care and prisons (2008. Smoking rooms are permitted in some enclosed places.	Canned in all broadcast media, print media and outdoors. Point of sale advertising permitted.	Yes	56
Spain	78 %	Total ban on smoking in enclosed public places, workplaces (2006), restaurants, bars and public transport (2011). Exemptions for designated hotel rooms and private smoking clubs	Banned in all broadcast media, print media & outdoors. Point of sale advertising permitted.	No	55

[a] Total tax as a percentage of the price of the most sold brand reported in 2016

[b] Tobacco Control Scale, designed to assess the implementation tobacco control policies at the country-level across Europe, higher scores indicate stronger tobacco control policies are in effect